



AF/1765/\$  
PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE  
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re the Application of:

DeGendt, et al.

Serial No: 09/022,834

Filed: February 13, 1998

For: **METHOD OF REMOVING ORGANIC  
CONTAMINANTS FROM A  
SEMICONDUCTOR SURFACE**

) Group Art Unit: 1765  
) Examiner: S. Ahmed  
) Docket Nos.: 98-162; 97/17  
) Confirmation No.: 6138  
)

TRANSMITTAL LETTER

Mail Stop Appeal Brief-Patents  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

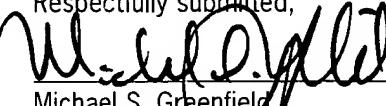
Dear Sir:

In regard to the above identified application,

1. We are transmitting herewith the attached:
  - a) Brief on Appeal; and
  - b) return receipt postcard.
2. With respect to fees:
  - a) Enclosed is a check in the amount of \$330.00.
  - b) Please charge any underpayment or credit any overpayment our Deposit Account, No. 13-2490.
3. CERTIFICATE OF MAILING UNDER 37 CFR § 1.8: The undersigned hereby certifies that this Transmittal Letter and the paper, as described in paragraph 1, are being deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on November 3, 2003.

Date: November 3, 2003

Respectfully submitted,

  
Michael S. Greenfield  
Registration No. 37,142



## PATENT

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## BRIEF ON APPEAL

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**BRIEF ON APPEAL**

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Commissioner for Patents  
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Alexandria, Virginia 22313-1450

Sir:

An original and three copies of this Appeal Brief are submitted along with the fee of three one hundred thirty dollars (\$330.00) for filing this Appeal Brief. A notice of appeal was filed on August 29, 2003.

In the event of any variance between any of the amounts enclosed and the Patent and Trademark Office charges, please charge or credit any difference to our Deposit Account No. 13-2490.

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### Claims on Appeal

### Appendix A

## **REAL PARTY IN INTEREST**

The real party in interest is Interuniversitair Micro-Elektronica Centrum vzm, to whom this invention is assigned.

## **RELATED APPEALS AND INTERFERENCES**

There are no related appeals or interferences concerning this application.

## **STATUS OF CLAIMS**

Claims 27 – 39 and 41 – 60 stand finally rejected under 35 U.S.C. § 103 in the Final Office Action dated May 5, 2003.

A clean set of the pending claims is attached in Appendix A.

## **STATUS OF AMENDMENTS**

There are no outstanding amendments.

## **SUMMARY OF THE INVENTION**

The invention relates to a method of removing contaminants from a substrate such as, for example, a semiconductor surface. Specification, p. 10., Ins. 18 – 20. The method can be used, for example, to remove photoresist and organic post-etch residues from silicon surfaces. *Id.*, p. 10, Ins. 21 – 27.

The method includes contacting the substrate with a liquid comprising water, ozone and an additive that acts as a scavenger, typically for  $\cdot\text{OH}$  radicals. *Id.*, p. 12, Ins. 28 – 34. In certain claimed embodiments, the invention is directed to a method of removing organic contaminants from a substrate by holding the substrate in a tank and filling the tank with water, ozone, and an additive that acts as a scavenger. *Id.* In some embodiments the additive is less than 1% of the molar weight of the fluid. In other embodiments the liquid is maintained at a temperature less than the boiling point of the liquid. *Id.*, p. 12, ln. 35 – p. 13, ln. 15.

## **ISSUES**

The issues presented to the Board for review by this appeal are:

(1) Whether claims 27 - 28, 30 - 32, 34 – 39, 41 – 43, 48 – 49, 51 – 54, 57 and 60 are obvious under 35 U.S.C. § 103(a) over Kashiwase et al. (U.S. Patent No. 5,378,317) in view of Sehested K, et al., *Decomposition of Ozone in Aqueous Acetic Acid Solutions (pH 0-4)*, J. Phys. Chem. (1992) 96:1005-009.

(2) Whether claims 33, 47 and 55 are obvious under 35 U.S.C. § 103(a) over Kashiwase et al. in view of Sehested et al., and further in view of Kern (Handbook of Semiconductor Wafer Cleaning Technology).

(3) Whether claims 29, 44 – 46, 50 and 58 – 59 are obvious over Kashiwase et al. in view of Kern and Sehested et al., further in view of Stanford et al. (U.S. Patent No. 5,244,000).

## **GROUPING OF THE CLAIMS**

The claims stand or fall together as a single group for the purposes of this appeal.

## **ARGUMENT**

In the broadest aspect, the claims are directed to a method of removing organic contaminants from a substrate comprising the use of a fluid comprising water, ozone, and an additive acting as a scavenger. All of the claims stand rejected as obvious over Kashiwase et al. and Sehested et al., with or without Kern or Stanford et al.

Kashiwase et al. teaches a two step photo resist film cleaning process comprising (1) immersing the film in a mixed solution of sulfuric acid and hydrogen peroxide followed by (for a substrate such as silicon) (2) rinsing with an aqueous ozone solution to remove remaining residue not removed by the first step. Kashiwase et al., col. 4, Ins. 22-36. The Examiner agrees that Kashiwase et al. is silent regarding the addition of an additive that acts as a scavenger. See Final Office Action, p. 4. Thus, there is no dispute that Kashiwase et al. fails to disclose the introduction of an additive such as acetic acid to an aqueous ozone solution. The only issue is whether the teaching of Sehested et al. that acetic acid stabilizes aqueous ozone bridges the gap between (a) Kashiwase et al.'s teaching of a method using water and ozone and (b) the presently claimed method comprising water, ozone, and an additive that acts as a scavenger.

While Sehested et al. teaches that acetic acid stabilizes aqueous ozone, neither it nor Kashiwase et al., nor any of the other cited art, make any connection between ozone stabilization and the ability of

aqueous ozone to clean organic contaminants from a substrate. That is, none of the cited art suggests that stabilization of ozone would lead to increased cleaning efficiency as observed by the present inventors. Indeed, none of the cited art teaches or suggests that ozone decomposition plays any significant role in diminishing the cleaning efficiency of aqueous ozone. Without a recognition that ozone decomposition diminishes the cleaning efficiency of aqueous ozone, there can be no motivation to stabilize the ozone and, therefore, no motivation to combine the references as the Examiner has done. See, e.g., *In re Sang Su Lee*, 277 F.3d 1338, 1343 (Fed. Cir. 2002).

Furthermore, whether ozone stabilization would lead to increased cleaning efficiency depends on a number of factors. These factors include, but are not limited to, the rate of cleaning, the rate of ozone decomposition, and the degree to which the ozone stabilizer decreases the rate of ozone decomposition and the relation of the decreased rate to the rate of cleaning. For instance, if the rate of cleaning were much faster than the rate of ozone decomposition (i.e., cleaning was essentially completed before significant amounts of ozone decomposed), stabilization of the ozone would be expected to have essentially no affect on the cleaning efficiency. Without a teaching of these factors, one of ordinary skill in the art would neither be motivated to employ a scavenger nor have a reasonable expectation that adding a scavenger to an aqueous ozone solution would lead to an increased cleaning efficiency, as observed by the inventors for the presently claimed methods.

Without a showing that the prior art can be modified or combined with a reasonable expectation of success, the Examiner cannot establish that the present invention is obvious in light of the prior art. *In re Merck & Co.*, 800 F.2d 1091 (Fed. Cir 1986). An acknowledged difference between the cited art and the present claims is that Kashiwase et al. teaches a cleaning step using aqueous ozone without a scavenger additive whereas the claimed method comprises cleaning using aqueous ozone with a scavenger additive. The specification presents a study comparing the cleaning efficiency of aqueous ozone without acetic acid as a scavenger (such as taught by Kashiwase et al.) to the method using acetic acid as a scavenger (as recited in the present claims). The experiments show that the presently claimed method provides an enhanced cleaning efficiency of 50% of implanted positive resist wafers, of up to 50% of un-implanted negative resist wafers, and of up to 88% of un-implanted positive resist wafers. Specification pp. 16-18 ("Application 2"). The prior art simply fails to provide any teachings or suggestion from which the ordinary artisan could reasonably have expected to observe the vastly improved cleaning capability of the present invention. Without this reasonable

expectation of success, the prior art can not render the present invention obvious. *Merck*, 800 F2d. at 1091.

In the Advisory Action mailed July 7, 2003, the Examiner cites Payton *et al.* (U.S. Patent No. 5,645,688) for the first time for the general proposition that it is well known that chemical constituents continuously decompose, thus lowering their concentration and utility. While this proposition may be correct generally, Payton *et al.* is completely irrelevant to the present invention. Payton *et al.* is directed to bleaching process for use in the production of paper pulps and textiles. Payton *et al.* teaches a bleaching process where the bleaching agent may be ozone. Payton *et al.* also teaches that when the bleaching agent is hydrogen peroxide (not ozone), certain chelating agents can be added to the bleaching process to form complexes with metals that would otherwise induce the breakdown of peroxide. (col. 2, lns 13-35).

Payton *et al.* adds nothing to the present analysis. Whether certain chelating agents can prevent the breakdown of peroxide during a paper bleaching process is irrelevant to whether an additive for stabilizing ozone would prove beneficial in a post-lithographic cleaning process on a semiconductor substrate. The general knowledge of one skilled in the art of chemistry that chemical constituents can decompose does not provide any motivation to combine the teachings of Kashiwase *et al.* and Sehested *et al.*, or provide a reasonable expectation of success without some specific teaching of such motivation or expectation. See, e.g., *In re Kotzab*, 217 F.3d 1365, 1371 (Fed. Cir. 2000) (“particular findings must be made as to the reason the skilled artisan, with no knowledge of the claimed invention, would have selected these components for combination in the manner claimed”). The applicants respectfully submit that without some recognition that the rate of ozone decomposition compared to the rate of cleaning is such that ozone decomposition detrimentally affects cleaning efficiency, there can be no motivation to stabilize the ozone through the addition of a scavenger nor any reasonable degree of assurance that doing so would have the kind of beneficial effect observed by the applicants. Thus, in light of the fact that the prior art lacks any teaching of a motivation to combine Kashiwase *et al.* and Sehested *et al.*, and that the prior art would not lead one of skill in the art to have a reasonable expectation of success of such a combination, the combination cannot render obvious the presently claimed invention.

With regard to dependent claims 33, 47 and 55, the Examiner cites Kern (Hand Book of Semiconductor Wafer Cleaning Technology) as teaching the introduction of megasonic agitation in

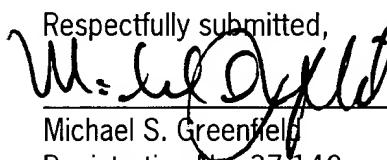
the cleaning process. However, Kern fails to cure the deficiency of Kashiwase et al. and Sehested et al. as it also fails to provide any suggestion that ozone decomposition detrimentally effects cleaning and that stabilization would improve it. Thus, Kern does not support the alleged case of obviousness against the independent claims from which claims 33, 47 and 55 depend. Given that the independent claims are patentable, the addition of Kern does not render obvious dependent claims 33, 47 and 55 that contain all the limitations of the independent claims.

With regard to dependent claims 29, 44 – 46, 50 and 58 – 59, the Examiner cites Stanford et al. (U.S. Patent No. 5,244,000) as teaching a rinsing step after the cleaning step, that the liquid can be sprayed on the substrate, and that the substrate may be treated with a rinse including carbon dioxide in deionized water. However, Stanford et al. fails to cure the deficiency of Kashiwase et al. and Sehested et al. as it also fails to provide any suggestion that ozone decomposition detrimentally effects cleaning and that stabilization would improve it. Thus Stanford does not support the alleged case of obviousness against the independent claims from which claims 29, 44 – 46, 50 and 58 – 59 ultimately depend. Given that the independent claims are patentable, the addition of Stanford et al. does not render obvious dependent claims 29, 44 - 46, 50 and 58 – 59 that contain all the limitations of the independent claims.

Claim 49 stands rejected under the judicially created doctrine of obviousness-type double patenting. Applicants confirm that they will consider filing an appropriate Terminal Disclaimer to obviate this rejection once the claims are in final form and otherwise allowable.

## CONCLUSION

In view of all of the foregoing, the Applicants submit that the present claims cannot be obvious over the cited art. Consequently, they respectfully request that the Board withdraw the rejections under 35 U.S.C. § 103, and remand the application to the Examiner for allowance.

Respectfully submitted,  
  
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## McDonnell Boehnen Hulbert & Berghoff

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## APPENDIX A

### Claims

27. A method for removing organic contaminants from a substrate, the organic contaminants resulting from a previous lithographic step, the method comprising the steps of:

contacting at least one side of said substrate with a liquid comprising water, ozone and an additive acting as a scavenger, wherein the proportion of said additive in said liquid is less than 1% molar weight of said liquid; and

maintaining said liquid at a temperature less than the boiling point of said liquid.

28. A method as recited in claim 27, wherein said temperature is lower than 100°C.

29. A method as recited in claim 27, wherein said liquid is sprayed over at least one side of said substrate.

30. A method as recited in claim 27, wherein said temperature is between 16°C and 99°C.

31. A method according as recited in claim 30, wherein the temperature of said liquid is between 20°C and 90°C.

32. A method according as recited in claim 31, wherein the temperature of said liquid is between 60°C and 80°C.

33. A method as recited in claim 27, wherein said liquid is subjected to megasonic agitation.

34. A method as recited in claim 27, wherein the ozone is bubbled through the liquid.

35. A method as recited in claim 27, wherein the organic contamination is a confined layer covering at least part of said substrate.

36. A method as recited in claim 35, wherein said confined layer has a thickness in a range of submonolayer coverage and 1 μm.

37. A method as recited in claim 27, wherein said additive is acting as OH radical scavenger.

38. A method as recited in claim 27, said additive is selected from the group consisting of a

carboxylic acid, a phosphonic acid, and salts thereof.

39. A method as recited in claim 38, wherein said additive is acetic acid.
41. A method according to claim 27, wherein the proportion of said additive in said liquid is less than .1% molar weight of said liquid.
42. A method according to claim 41, wherein the proportion of said additive in said liquid is less than 0.1% molar weight of said liquid.
43. A method as recited in claim 27, wherein the ozone includes ozone bubbles and wherein the ozone bubbles are contacting said organic contaminants.
44. A method as recited in claim 27, further comprising the step of rinsing said substrate with a solution.
45. A method as recited in claim 44, wherein said solution comprises de-ionised water.
46. A method as recited in claim 45, wherein said solution further comprises at least one solution selected from the group consisting of HCl, HF, HNO<sub>3</sub>, CO<sub>2</sub> and O<sub>3</sub>.
47. A method as recited in claim 44, wherein said solution is subjected to megasone agitation.
48. A method as recited in claim 27, wherein said substrate is a silicon wafer.
49. A method for removing organic contaminants from a substrate comprising the steps of:  
holding said substrate in tank; and  
filling said tank with a fluid comprising water, ozone and an additive acting as a scavenger, and wherein the proportion of said additive in said fluid is less than 1% molar weight of said fluid.
50. A method as recited in claim 27, wherein at least one side of said substrate is in contact with a mist of said liquid.
51. A method for removing organic contaminants from a substrate, the organic contaminants resulting from a previous lithographic step, the method comprising the steps of:  
contacting at least one side of said substrate with a liquid comprising water, ozone and an

additive acting as a scavenger, wherein said liquid is comprised substantially of water; and maintaining said liquid at a temperature less than the boiling point of said liquid.

52. A method as recited in claim 51, wherein the proportion of said additive in said liquid is less than 1% molar weight of said liquid.

53. A method according to claim 52, wherein the proportion of said additive in said liquid is less than 0.1% molar weight of said liquid.

54. A method as recited in claim 51, wherein the temperature of said liquid is between 60°C and 80°C.

55. A method as recited in claim 51, wherein said liquid is subjected to megasone agitation.

56. A method as recited in claim 51, wherein the ozone is bubbled through the liquid.

57. A method as recited in claim 51, wherein said additive is acting as OH radical scavenger.

58. A method as recited in claim 51, further comprising the step of rinsing said substrate with a solution.

59. A method as recited in claim 58, wherein said solution comprises de-ionised water.

60. A method for removing organic contaminants from a substrate, the organic contaminants resulting from a previous lithographic step, the method comprising the steps of:

holding said substrate in a tank; and

filling said tank with a fluid comprising water, ozone and an additive acting as a scavenger, and wherein the fluid is comprised substantially of water.

## **REAL PARTY IN INTEREST**

The real party in interest is Interuniversitair Micro-Elektronica Centrum vzm, to whom this invention is assigned.

## **RELATED APPEALS AND INTERFERENCES**

There are no related appeals or interferences concerning this application.

## **STATUS OF CLAIMS**

Claims 27 – 39 and 41 – 60 stand finally rejected under 35 U.S.C. § 103 in the Final Office Action dated May 5, 2003.

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## **ISSUES**

The issues presented to the Board for review by this appeal are:

(1) Whether claims 27 - 28, 30 - 32, 34 – 39, 41 – 43, 48 – 49, 51 – 54, 57 and 60 are obvious under 35 U.S.C. § 103(a) over Kashiwase *et al.* (U.S. Patent No. 5,378,317) in view of Sehested K, *et al.*, *Decomposition of Ozone in Aqueous Acetic Acid Solutions (pH 0-4)*, *J. Phys. Chem.* (1992) 96:1005-009.

(2) Whether claims 33, 47 and 55 are obvious under 35 U.S.C. § 103(a) over Kashiwase *et al.* in view of Sehested *et al.*, and further in view of Kern (*Handbook of Semiconductor Wafer Cleaning Technology*).

(3) Whether claims 29, 44 – 46, 50 and 58 – 59 are obvious over Kashiwase *et al.* in view of Kern and Sehested *et al.*, further in view of Stanford *et al.* (U.S. Patent No. 5,244,000).

## **GROUPING OF THE CLAIMS**

The claims stand or fall together as a single group for the purposes of this appeal.

## **ARGUMENT**

In the broadest aspect, the claims are directed to a method of removing organic contaminants from a substrate comprising the use of a fluid comprising water, ozone, and an additive acting as a scavenger. All of the claims stand rejected as obvious over Kashiwase *et al.* and Sehested *et al.*, with or without Kern or Stanford *et al.*.

Kashiwase *et al.* teaches a two step photo resist film cleaning process comprising (1) immersing the film in a mixed solution of sulfuric acid and hydrogen peroxide followed by (for a substrate such as silicon) (2) rinsing with an aqueous ozone solution to remove remaining residue not removed by the first step. Kashiwase *et al.*, col. 4, lns. 22-36. The Examiner agrees that Kashiwase *et al.* is silent regarding the addition of an additive that acts as a scavenger. See Final Office Action, p. 4. Thus, there is no dispute that Kashiwase *et al.* fails to disclose the introduction of an additive such as acetic acid to an aqueous ozone solution. The only issue is whether the teaching of Sehested *et al.* that acetic acid stabilizes aqueous ozone bridges the gap between (a) Kashiwase *et al.*'s teaching of a method using water and ozone and (b) the presently claimed method comprising water, ozone, and an additive that acts as a scavenger.

While Sehested *et al.* teaches that acetic acid stabilizes aqueous ozone, neither it nor Kashiwase *et al.*, nor any of the other cited art, make any connection between ozone stabilization and the ability of

aqueous ozone to clean organic contaminants from a substrate. That is, none of the cited art suggests that stabilization of ozone would lead to increased cleaning efficiency as observed by the present inventors. Indeed, none of the cited art teaches or suggests that ozone decomposition plays any significant role in diminishing the cleaning efficiency of aqueous ozone. Without a recognition that ozone decomposition diminishes the cleaning efficiency of aqueous ozone, there can be no motivation to stabilize the ozone and, therefore, no motivation to combine the references as the Examiner has done. See, e.g., *In re Sang Su Lee*, 277 F.3d 1338, 1343 (Fed. Cir. 2002).

Furthermore, whether ozone stabilization would lead to increased cleaning efficiency depends on a number of factors. These factors include, but are not limited to, the rate of cleaning, the rate of ozone decomposition, and the degree to which the ozone stabilizer decreases the rate of ozone decomposition and the relation of the decreased rate to the rate of cleaning. For instance, if the rate of cleaning were much faster than the rate of ozone decomposition (i.e., cleaning was essentially completed before significant amounts of ozone decomposed), stabilization of the ozone would be expected to have essentially no affect on the cleaning efficiency. Without a teaching of these factors, one of ordinary skill in the art would neither be motivated to employ a scavenger nor have a reasonable expectation that adding a scavenger to an aqueous ozone solution would lead to an increased cleaning efficiency, as observed by the inventors for the presently claimed methods.

Without a showing that the prior art can be modified or combined with a reasonable expectation of success, the Examiner cannot establish that the present invention is obvious in light of the prior art. *In re Merck & Co.*, 800 F.2d 1091 (Fed. Cir 1986). An acknowledged difference between the cited art and the present claims is that Kashiwase et al. teaches a cleaning step using aqueous ozone without a scavenger additive whereas the claimed method comprises cleaning using aqueous ozone with a scavenger additive. The specification presents a study comparing the cleaning efficiency of aqueous ozone without acetic acid as a scavenger (such as taught by Kashiwase et al.) to the method using acetic acid as a scavenger (as recited in the present claims). The experiments show that the presently claimed method provides an enhanced cleaning efficiency of 50% of implanted positive resist wafers, of up to 50% of un-implanted negative resist wafers, and of up to 88% of un-implanted positive resist wafers. Specification pp. 16-18 ("Application 2"). The prior art simply fails to provide any teachings or suggestion from which the ordinary artisan could reasonably have expected to observe the vastly improved cleaning capability of the present invention. Without this reasonable

expectation of success, the prior art can not render the present invention obvious. *Merck*, 800 F2d. at 1091.

In the Advisory Action mailed July 7, 2003, the Examiner cites Payton *et al.* (U.S. Patent No. 5,645,688) for the first time for the general proposition that it is well known that chemical constituents continuously decompose, thus lowering their concentration and utility. While this proposition may be correct generally, Payton *et al.* is completely irrelevant to the present invention. Payton *et al.* is directed to bleaching process for use in the production of paper pulps and textiles. Payton *et al.* teaches a bleaching process where the bleaching agent may be ozone. Payton *et al.* also teaches that when the bleaching agent is hydrogen peroxide (not ozone), certain chelating agents can be added to the bleaching process to form complexes with metals that would otherwise induce the breakdown of peroxide. (col. 2, lns 13-35).

Payton *et al.* adds nothing to the present analysis. Whether certain chelating agents can prevent the breakdown of peroxide during a paper bleaching process is irrelevant to whether an additive for stabilizing ozone would prove beneficial in a post-lithographic cleaning process on a semiconductor substrate. The general knowledge of one skilled in the art of chemistry that chemical constituents can decompose does not provide any motivation to combine the teachings of Kashiwase *et al.* and Sehested *et al.*, or provide a reasonable expectation of success without some specific teaching of such motivation or expectation. See, e.g., *In re Kotzab*, 217 F.3d 1365, 1371 (Fed. Cir. 2000) ("particular findings must be made as to the reason the skilled artisan, with no knowledge of the claimed invention, would have selected these components for combination in the manner claimed"). The applicants respectfully submit that without some recognition that the rate of ozone decomposition compared to the rate of cleaning is such that ozone decomposition detrimentally affects cleaning efficiency, there can be no motivation to stabilize the ozone through the addition of a scavenger nor any reasonable degree of assurance that doing so would have the kind of beneficial effect observed by the applicants. Thus, in light of the fact that the prior art lacks any teaching of a motivation to combine Kashiwase *et al.* and Sehested *et al.*, and that the prior art would not lead one of skill in the art to have a reasonable expectation of success of such a combination, the combination cannot render obvious the presently claimed invention.

With regard to dependent claims 33, 47 and 55, the Examiner cites Kern (Hand Book of Semiconductor Wafer Cleaning Technology) as teaching the introduction of megasonic agitation in

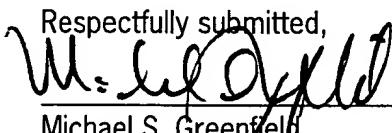
the cleaning process. However, Kern fails to cure the deficiency of Kashiwase *et al.* and Sehested *et al.* as it also fails to provide any suggestion that ozone decomposition detrimentally effects cleaning and that stabilization would improve it. Thus, Kern does not support the alleged case of obviousness against the independent claims from which claims 33, 47 and 55 depend. Given that the independent claims are patentable, the addition of Kern does not render obvious dependent claims 33, 47 and 55 that contain all the limitations of the independent claims.

With regard to dependent claims 29, 44 – 46, 50 and 58 – 59, the Examiner cites Stanford *et al.* (U.S. Patent No. 5,244,000) as teaching a rinsing step after the cleaning step, that the liquid can be sprayed on the substrate, and that the substrate may be treated with a rinse including carbon dioxide in deionized water. However, Stanford *et al.* fails to cure the deficiency of Kashiwase *et al.* and Sehested *et al.* as it also fails to provide any suggestion that ozone decomposition detrimentally effects cleaning and that stabilization would improve it. Thus Stanford does not support the alleged case of obviousness against the independent claims from which claims 29, 44 – 46, 50 and 58 – 59 ultimately depend. Given that the independent claims are patentable, the addition of Stanford *et al.* does not render obvious dependent claims 29, 44 - 46, 50 and 58 – 59 that contain all the limitations of the independent claims.

Claim 49 stands rejected under the judicially created doctrine of obviousness-type double patenting. Applicants confirm that they will consider filing an appropriate Terminal Disclaimer to obviate this rejection once the claims are in final form and otherwise allowable.

## CONCLUSION

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Respectfully submitted,  
  
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Michael S. Greenfield  
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## APPENDIX A

### Claims

27. A method for removing organic contaminants from a substrate, the organic contaminants resulting from a previous lithographic step, the method comprising the steps of:
  - contacting at least one side of said substrate with a liquid comprising water, ozone and an additive acting as a scavenger, wherein the proportion of said additive in said liquid is less than 1% molar weight of said liquid; and
  - maintaining said liquid at a temperature less than the boiling point of said liquid.
28. A method as recited in claim 27, wherein said temperature is lower than 100°C.
29. A method as recited in claim 27, wherein said liquid is sprayed over at least one side of said substrate.
30. A method as recited in claim 27, wherein said temperature is between 16°C and 99°C.
31. A method according as recited in claim 30, wherein the temperature of said liquid is between 20°C and 90°C.
32. A method according as recited in claim 31, wherein the temperature of said liquid is between 60°C and 80°C.
33. A method as recited in claim 27, wherein said liquid is subjected to megasonic agitation.
34. A method as recited in claim 27, wherein the ozone is bubbled through the liquid.
35. A method as recited in claim 27, wherein the organic contamination is a confined layer covering at least part of said substrate.
36. A method as recited in claim 35, wherein said confined layer has a thickness in a range of submonolayer coverage and 1  $\mu\text{m}$ .
37. A method as recited in claim 27, wherein said additive is acting as OH radical scavenger.
38. A method as recited in claim 27, said additive is selected from the group consisting of a

carboxylic acid, a phosphonic acid, and salts thereof.

39. A method as recited in claim 38, wherein said additive is acetic acid.
41. A method according to claim 27, wherein the proportion of said additive in said liquid is less than .1% molar weight of said liquid.
42. A method according to claim 41, wherein the proportion of said additive in said liquid is less than 0.1% molar weight of said liquid.
43. A method as recited in claim 27, wherein the ozone includes ozone bubbles and wherein the ozone bubbles are contacting said organic contaminants.
44. A method as recited in claim 27, further comprising the step of rinsing said substrate with a solution.
45. A method as recited in claim 44, wherein said solution comprises de-ionised water.
46. A method as recited in claim 45, wherein said solution further comprises at least one solution selected from the group consisting of HCl, HF, HNO<sub>3</sub>, CO<sub>2</sub> and O<sub>3</sub>.
47. A method as recited in claim 44, wherein said solution is subjected to megasone agitation.
48. A method as recited in claim 27, wherein said substrate is a silicon wafer.
49. A method for removing organic contaminants from a substrate comprising the steps of:  
holding said substrate in tank; and  
filling said tank with a fluid comprising water, ozone and an additive acting as a scavenger, and wherein the proportion of said additive in said fluid is less than 1% molar weight of said fluid.
50. A method as recited in claim 27, wherein at least one side of said substrate is in contact with a mist of said liquid.
51. A method for removing organic contaminants from a substrate, the organic contaminants resulting from a previous lithographic step, the method comprising the steps of:  
contacting at least one side of said substrate with a liquid comprising water, ozone and an

additive acting as a scavenger, wherein said liquid is comprised substantially of water; and  
maintaining said liquid at a temperature less than the boiling point of said liquid.

52. A method as recited in claim 51, wherein the proportion of said additive in said liquid is less than 1% molar weight of said liquid.

53. A method according to claim 52, wherein the proportion of said additive in said liquid is less than 0.1% molar weight of said liquid.

54. A method as recited in claim 51, wherein the temperature of said liquid is between 60°C and 80°C.

55. A method as recited in claim 51, wherein said liquid is subjected to megasone agitation.

56. A method as recited in claim 51, wherein the ozone is bubbled through the liquid.

57. A method as recited in claim 51, wherein said additive is acting as OH radical scavenger.

58. A method as recited in claim 51, further comprising the step of rinsing said substrate with a solution.

59. A method as recited in claim 58, wherein said solution comprises de-ionised water.

60. A method for removing organic contaminants from a substrate, the organic contaminants resulting from a previous lithographic step, the method comprising the steps of:

holding said substrate in a tank; and

filling said tank with a fluid comprising water, ozone and an additive acting as a scavenger, and wherein the fluid is comprised substantially of water.